TRANSMITTAL LETTER FOR A PCT INTERNATIONAL APPLICATION ENTERING THE NATIONAL STAGE IN THE U.S. AS A DESIGNATED or ELECTED OFFICE UNDER 35 USC 371

Attorney's Docket No.: SHIBP004

Date: April 17, 2000

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Transmitted herewith are the papers required to enter the national state in the U.S. as a designated office/elected office for the following PCT international patent application:

INTERNATIONAL APPLICATION NUMBER: PCT/JP99/04626
Int'l Filing Date: August 26, 1999
1st Priority Date: August 26, 1998
Inventor(s): Youji ITO
For: PROCESSING SYSTEM FOR PROCESSING BUILDING STRUCTURAL COMPONENTS

The United States Patent Office is: (select one)
_X_   A Designated Office (No Demand was filed - See 37 CFR 1.494)
____   An Elected Office (A Demand for Preliminary Examination was Filed - See 37 CFR 1.495)

Enclosed are:

____   A copy of the international application (if this line is not checked, the international application was previously communicated by the International Bureau or the international application was originally filed in the USPTO).
_X_   An English Translation of the International Application
____   A Combined Declaration and Power of Attorney
____   A copy of amendments made under PCT Article 19
_X_   A translation of amendments made under PCT Article 19
____   A translation of annexes to the international preliminary examination report
____   Verified Statement establishing Small Entity Status under 37 CFR 1.9 and 1.27.
____   An Assignment of the Invention to: ***.
               (with $40.00 recordal fee)
____   Information Disclosure Statement
_X_   A Preliminary Amendment

___ A copy of the International Search Report
___ A copy of the Preliminary Examination Report
_X_ A check to cover the filing fees (including the basic national fee under 37 CFR 1.492(a)) in the amount calculated below:

FEE CALCULATION

_X_ BASIC FEE $970
(IPEA-U.S. $670/335; ISA-U.S. $760/380; PTO not ISA or IPEA $970/485;
U.S. IPEA all claims meet 33(2)-(4) $96/48; File w/ EPO or JPO search report $840/420;)

___ Surcharge for filing a late oath or declaration ($130/65)	$ ***	
___ Surcharge for filing a late translation ($130)	$ ***	
___ Multiple dependent claims ($260/130)		$ ***
___ Excess claims - see calculation below		$ ***

Total Claims:	11 - 20 = 00	X $18/9 claim =			$ -0-
Independent Claims:	02 - 03 = 00	X $78/39 ind. claim =			$ -0-

Excess Claim Total $ -0-

___ Assignment recordal fee ($40) $ ***

TOTAL FEES $970

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_X_ The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to Deposit Account No. 50-0388 (Order No. SHIBP004). A duplicate copy of this transmittal is enclosed.

Respectfully submitted.

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Applicant/Patentee: _____ ITO   Hiromichi _____

Application or Patent No. __09/529,765_____ Atty Docket #__SHIBP004_____

Filed or Issued: __April 17, 2000_____

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
37 CFR 1.9(f) and 1.27(c)--SMALL BUSINESS CONCERN

I hereby declare that I am
[*] the owner of the small business concern identified below:
[   ] an official empowered to act on behalf of the small business concern identified below:

NAME OF CONCERN: ___KABUSHIKIKAISYA ENU SHI ENU_____

ADDRESS: __1001, Makino, Minokamo-shi, Gifu-ken,   501-3700   JAPAN_____

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under 41(a) and (b) of Title 35, U.S. Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled: PROCESSING SYSTEM FOR PROCESSING BUILDING STRUCTURAL COMPONENTS, by inventor(s) _____ITO   Hiromichi_____, described in

     [   ] the specification filed herewith.
     [*] Application No. PCT/JP99/04626 filed on 26 August, 1999
     [   ] patent #_____ issued _____

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). *Note: separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

Name: _____
Address: _____
     [ ] individual   [ ] small business concern   [ ] nonprofit organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the U.S. Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: ___SUGIYAMA   Tsuneo_____

TITLE IN ORGANIZATION: _____President_____

SIGNATURE _____ DATE April 24, 2000___

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Youji ITO

Application No.: Unassigned

Filed: Herewith

Title: PROCESSING SYSTEM FOR
PROCESSING BUILDING STRUCTURAL
COMPONENTS

Attorney Docket No.: SHIBP004

Examiner: Unassigned

Group: Unassigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C.   20231
BOX PCT

Sir:

Please enter the following amendment prior to calculating the filing fee and examination

of the above-identified application.

IN THE CLAIMS:

Please AMEND claims 3, 4, 5, 9, 10 & 11 as follows:

3.   A processing system for processing building structural components according to claim 1

[or 2], wherein said strengths are grouped into a plurality of different bands based on magnitudes

of said strengths, wherein each of said strength level display modes is assigned to each of said

corresponding bands.

4.   A processing system for processing building structural components according to [any one

of] claim[s] 1 [to 3], wherein said two-dimensional diagram constructing means projects a cross

section of said virtual three-dimensional model onto said plane, wherein said cross section of

said virtual three-dimensional model is obtained by cutting said virtual three-dimensional model at a desired position.

5. A processing system for processing building structural components according to [any one of] claim[s] 1 [to 4], wherein said strength level display modes are colors provided in said two-dimensional diagram.

9. A processing system for processing building structural components according to [any one of] claim[s] 6 [to 8], wherein said two-dimensional diagram constructing means projects a cross section of said virtual three-dimensional model onto said plane, wherein said cross section of said virtual three-dimensional model is obtained by cutting said virtual three-dimensional model at a desired position.

10. A processing system for processing building structural components according to [any one of] claim[s] 6 [to 9], wherein said strength level display modes are colors provided in said two-dimensional diagram.

11. A processing system for processing building structural components according to [any one of] claim[s] 2 [to 10], wherein said costs estimated by said cost estimating means are different from actual costs of said building structural components that are computed based on actual shape data of said respective building structural components.

If any fees are due in connection with the filing of this Preliminary Amendment, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-0388 (Order No. SHIBP004)

Respectfully submitted,
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PROCESSING SYSTEM FOR PROCESSING BUILDING STRUCTURAL
COMPONENTS

FIELD OF THE INVENTION

This invention relates generally to designing of
building structures, and more particularly to a processing
system for processing building structural components. In the
processing system, a building structure is designed with a
CAD (Computer Aided Design) device, and thereafter the data
of the CAD device is transferred to a CAM (Computer Aided
Manufacturing) device through a communication network such as
a LAN (Local Area Network).

BACKGROUND OF THE INVENTION

In conventional methods of construction, frameworks,
roof trusses and floor trusses are constructed at a
construction site with building structural components, which
are precut in a factory based on specified dimensions and
specified joint types. This precut system allows the
processed building structural components to be assembled at
construction sites without requiring any further process of
these building structural components, so that a construction
period is significantly reduced.

The building structural components are precut in the
following sequence. First, data of the frameworks such as
columns and beams to be arranged on a foundation, data of the
roof trusses, data of the floor trusses, data of openings and
material data are inputted into the CAD device. These data
are stored as CAD data along with supplemental data (such as
data of plotting manner, colors and others) that are
previously provided in a CAD program. Among these stored CAD
data, data required for precutting of the building structural
components, such as shape data and material type data of the

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building structural components, are printed out on a sheet. Then, these required data are manually inputted into a precut CAD device from the printed data sheet. Furthermore, at this stage, additional data, such as data of joints, data of bolt holes for splicing fittings and data of slits, are also inputted into the precut CAD device. Among these data, the shape data, the material type data and the additional data are used as precut data.

These precut data are transferred from the precut CAD device to a precut CAM device arranged in the factory through a communication line. Then, the precut CAM device cuts the materials based on the shape data of each building structural component.

Since the material type data and the dimension data of each building structural component must be retrieved and printed out from the CAD device and then inputted into the precut CAD device, the operation is tedious and time consuming. Furthermore, if a designer changes the design of the building structure after reexamining the design or after considering customer's request, the inputted CAD data should be modified. In such case, the data of the precut CAD device should also be modified, resulting tedious and time consuming modifying operation. Furthermore, these data are inputted into the precut CAD device by man power, so that there is always a possibility of input mistakes. Therefore, very careful data input work is required to avoid the input mistakes.

Furthermore, the changes in the design of the building structure after reexamining the design or after considering customer's request are often made as a result of considering strength data or cost data of the building structural

components after these data are computed. Therefore, these data must be computed separately, resulting additional work.

The present invention addresses these disadvantages. An objective of the present invention is to provide an integral processing system capable of designing the building structures, reexamining designs of the building structures, and processing the building structural components of the building structures based on the CAD data formed with a CAD device.

SUMMARY OF THE INVENTION

To achieve the objective of the present invention, a processing system for processing building structural components constituting a building structure includes a first station comprising: an input means for inputting at least shape data and relative position data of the building structural components; a two-dimensional diagram constructing means for constructing a two-dimensional diagram, wherein the two-dimensional diagram constructing means first constructs a virtual three-dimensional model of the building structural components based on the various data inputted from the input means and also supplemental data arranged in a CAD program, and then constructs the two-dimensional diagram by projecting selected building structural components, which are selected from the building structural components of the virtual three-dimensional model, onto a plane; a display means for displaying the two-dimensional diagram constructed by the two-dimensional diagram constructing means on a display screen; a storage means for storing CAD data for constructing the virtual three-dimensional model constructed by the two-dimensional diagram constructing means; and a strength computing means for computing strengths of the selected building structural components based on the CAD data

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retrieved from the storage means; and a second station comprising a processing means for processing each of the building structural components based on the CAD data retrieved from the storage means, wherein the processing means is interconnected with the first station through a communication line.

Alternatively, the processing system for processing building structural components constituting a building structure includes a first station comprising: an input means for inputting at least shape data and relative position data of the building structural components; a two-dimensional diagram constructing means for constructing a two-dimensional diagram, wherein the two-dimensional diagram constructing means first constructs a virtual three-dimensional model of the building structural components based on the various data inputted from the input means and also supplemental data arranged in a CAD program, and then constructs the two-dimensional diagram by projecting selected building structural components, which are selected from the building structural components of the virtual three-dimensional model, onto a plane; a display means for displaying the two-dimensional diagram constructed by the two-dimensional diagram constructing means on a display screen; a storage means for storing CAD data for constructing the virtual three-dimensional model constructed by the two-dimensional diagram constructing means; and a cost estimating means for estimating costs of the building structural components based on the CAD data retrieved from the storage means; and a second station comprising a processing means for processing each of the building structural components based on the CAD data retrieved from the storage means, wherein the processing means is interconnected with the first station through a communication line.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an electrical structure according to an embodiment of the present invention.

Fig. 2 is a block diagram showing steps of the same embodiment.

Fig. 3 is a table showing relationships between dimensions and their corrected values;

Fig. 4 is a descriptive view showing part of a cost estimation table.

Fig. 5 is a descriptive view of a strength distribution diagram displayed on a display screen.

Fig. 6 is a table showing relationships between the strengths and corresponding colors thereof.

Fig. 7 is a table showing attributes of one building structural component that is arranged in the strength distribution diagram displayed on the display screen.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A processing system for processing building structural components of building structures (hereinafter referred as a processing system) in accordance with one embodiment of the present invention will now be described with reference to Figs. 1 to 7.

As shown in Fig. 1, the processing system includes a CPU (Central Processing Unit) 11 that is interconnected with a ROM (Read Only Memory) 12, a RAM (Random Access Memory) 13, a magnetic disk device 14, an input device 15, a mouse 16, a display unit 17 and a printer 18. The CPU 11 and the described peripheral devices constitute a first station A. The CPU 11 is further interconnected with a CAM device 21 that constitutes a second station B through a communication line 20.

A program for controlling operation of the entire processing system, a data base management program for managing a data base, a network processing program for controlling the communication network, an OA processing program for managing common functions (such as Japanese input function and print function) of various programs are stored in the ROM 12. The RAM 13 is a rewritable memory for temporarily storing various information required for operations of the CPU 11. A CAD program for designing the building structural components, a cost estimation program for estimating costs of the building structural components based on the data of the designed building structural components, and a strength computation program for computing strengths of the building structural components are stored in the magnetic disk device 14.

Furthermore, the CAD data, which is formed by the CAD program, is stored in the magnetic disk device 14. The CPU 11 transfers the CAD data from the magnetic disk device 14 to the RAM 13 when the cost estimation program or the strength computation program are executed.

Various instructions and data are inputted into the CPU 11 through the input device 15. The input device 15 includes select keys 15a, numeric keys 15b and an enter key 15c. The select keys 15a are used to select one of the CAD program, the cost estimation program and the strength computation program for execution, or are used to select any desired process. The numeric keys 15b are used to enter new data. The enter key 15c is used to execute the selected program or process and to define data contents. The mouse 16 is an auxiliary device of the input device 15 and can provide functions similar to that of the select keys 15a and the

enter key 15c by moving a mouse cursor to a directive box displayed on a display screen of the display unit 17 and then pressing a button switch.

The display unit 17 displays a CAD diagram, such as a virtual three dimensional model of a building structure, on its display screen based on the CAD data of the CAD program retrieved from the RAM 13. The display unit 17 further displays a cost estimation table formed with the cost estimation program, and also a strength distribution diagram 23 formed with the strength computation program. The printer 18 prints out various information, such as the virtual three dimensional model and the cost estimation table displayed on the display screen of the display unit 17. The CAM device 21 is used to process materials based on the process data and is controlled by a CPU (not shown) arranged in the CAM device 21.

With reference to Fig. 2, a first step I will now be described. In step I, a building structure is designed with the CAD program, and the data of the designed building structure is stored as the CAD data. First, the CPU 11 retrieves the CAD program from the magnetic disk device 14 and transfers it to the RAM 13. By operating the input device 15 or the mouse 16, the CAD program stored in the RAM 13 is invoked on the display screen of the display unit 17, and shape data, relative position data, load data, and connection process data, such as data of joints, data of bolt holes for splicing fittings and data of slits, are inputted. Also, in this embodiment, the data that are not directly associated with the structure, i.e., specification data (such as types, installation areas and sizes) of roof materials, wall materials, floor materials, and interior components, such as stairs, windows and doors, are inputted for use in the cost estimation with the cost estimation program

described further below. Furthermore, supplemental data
(such as data of material types (wood species), plotting
manner and display colors of the building structural
components) provided in the CAD program are selected to
provide the CAD data that allows construction of the virtual
three dimensional model. The CPU 11 temporarily stores the
CAD data in the RAM 13. Thereafter, the CPU 11 stores the
CAD data in the magnetic disk device 14.

A second step II of Fig. 2 for constructing the cost
estimation table with the cost estimation program based on
the CAD data will now be described. The CPU 11 retrieves the
cost estimation program from the magnetic disk device 14 and
transfers it to the RAM 13. The CPU 11 also retrieves the
data that are associated with the structure, i.e., the shape
data and material type (wood species) data contained in the
CAD data, from the magnetic disk device 14, and transfers
these data to the RAM 13. Furthermore, the data that are not
directly associated with the structure, i.e., the
specification data of the roof materials, the wall materials,
the floor materials, and the interior components, such as the
stairs, the windows and the doors, are also retrieved from
the magnetic disk device 14, and are transferred to the RAM
13.

With reference to Fig. 3, the cost estimation program
includes a table T1 showing relationships between the actual
dimensions of the building structural components and the
corrected dimensions of the building structural components
used for cost estimation purpose. The actual dimensions of
the building structural components are corrected to the
corrected dimensions of the building structural components
based on the table T1. For example, if the actual dimensions
(length: width: thickness) of a column B are 6020 mm : 135

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mm : 135 mm, the corrected length will be 6100 mm, the
corrected width will be 140 mm, and the corrected thickness
will be 140 mm. Since the specification data of the roof
materials, the wall materials, the floor materials, and the
interior components, such as the stairs, the windows and the
doors are selected from those of standard products in step I,
the costs of the roof materials, the wall materials and the
floor materials are determined based on the selected standard
products and their installation areas. Furthermore, the
costs of the interior components, such as the stairs, the
windows and the doors are determined based on the selected
standard products and their sizes.

Fig. 4 shows part of the exemplary cost estimation
table 24. In this embodiment, unit cost per one cubic meter
is provided for each material types (wood species). In the
cost estimation table 24, although the column B is indicated
with the actual dimensions, the corrected dimensions of the
column B described above are used when the volume and the
cost of the column B are computed. For the column B,
although the actual volume is 1.09714 cubic meter per piece,
the corrected volume is 1.1956 cubic meter per piece when it
is corrected in the manner described above. Therefore, the
displayed cost of the column B, which is based on the
corrected volume, is higher than the actual cost of the
column B, which is based on the actual volume. The cost of
each building structural component, the cost of each
attribute group (such as a group of columns or a group of
beams) , or the cost of the entire building structural
components can be computed separetely.

In addition to the costs of the structural components,
the cost of each major component other than the structural
components can be computed from the specification data of the

interior components, and the sub-total cost and the total cost of these major components other than the structural components can be computed.

A third step III of Fig. 2 for constructing the strength distribution diagram 23 based on the CAD data with the strength computation program will now be described. The CPU 11 retrieves the strength computation program from the magnetic disk device 14 and transfers it to the RAM 13. The CPU 11 retrieves the shape data, the relative position data and the load data, which are contained in the CAD data, from the magnetic disk device 14 and transfers them to the RAM 13.

The CPU 11 then constructs the virtual three-dimensional model of the building structure based on the shape data and the relative position data. In this embodiment, a plan cross sectional view, which is obtained by horizontally cutting the virtual three-dimensional model of the building structure, is displayed on the display screen of the display unit 17 as the two-dimensional diagram.

After examining attributes of the building structural components required for the building structure, desired load data of the floors and desired load data of the walls are inputted. Alternatively, original settings of these load data can be used without any changes.

The strength computation is conducted by operating the input device 15 or the mouse 16. That is, stress values of columns 25a-25m, beams 26a-26m and braces 27a-27f, which are subjects of the strength computation, are computed. Then, the strength distribution diagram 23 is displayed on the display screen of the display unit 17, as shown in Fig. 5. In the strength distribution diagram 23, the columns 25a-25m,

the beams 26a-26m and the braces 27a-27f are shown with corresponding colors that are determined based on the computed stress values.

As shown in Figs. 6 and 7, the color of each component may vary depending on the computed stress value of the component, and therefore the strength of the component is indicated with the respective color. In this embodiment, six colors can be used depending on the stress value of the component, as shown in Fig. 6. Among these colors, blue indicates the greatest strength (the smallest stress value), and red indicates the smallest strength (the largest stress value). The strengths are decreased in the order blue > light blue > yellow green > yellow > pink > red. The relationships between the colors and the stress values can be changed as desired. For example, although blue is initially set for a stress value range of 0-0.24, this stress value range for blue can be changed to 0-0.49. This change can be conducted on a table shown in Fig. 7 by operating the mouse 16.

Stress types computed herein include bending stress (M), sharing stress (Q), compressive stress (N), tensile stress (T), bending stress + compressive stress (M+N) and strain ( ) of each building structural component, and bending stress (jM), shearing stress (jQ), compressive stress (jN), tensile stress (jT) and bending stress + compressive stress (jM+N) of a joint of each building structural component.

The load data for computing the stress values include fixed load (own weight of the component + total weight of three standard adults 180kg: L), fixed load + snow load (L+S), fixed load + X-direction seismic force (L+±EX), fixed load + Y-direction seismic force (L+±EY), fixed load + X-direction

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wind pressure (L+±WX), fixed load + Y-direction wind pressure (L+±WY) and fire load (fire). Stress values (a total of 121 values) are derived from combinations of all of the described stresses and all of the described loads for each building structural component that is a subject of the strength computation.

As shown in Fig. 7, the attributes of each building structural component arranged in the strength distribution diagram 23 can be displayed on the display screen by operating the input device 15 or the mouse 16. In this embodiment, as an example, computed stress values for the various load data of the beam 28a (G4) are shown. Furthermore, in the strength distribution diagram 23, the worst load data (indicated as "worst" in Fig. 7) and the worst stress value (also indicated as "worst" in Fig. 7) of each building structural component are used as parameters for determining the colors of the building structural components in the default setting. That is, if one computed stress value of any building structural component is larger than the rest of the computed stress values of the same building structural component, this component is displayed with the color that corresponds with the larger computed stress value even if the other computed stress values are smaller than this larger stress value. Besides the "worst" one, the parameter can be changed to any one, such as the fixed load + the snow load (L+S).

The strength distribution diagram 23 is then printed out through the printer 18.

As described above, the cost estimation table 24 is first constructed with the cost estimation program based on the CAD data formed with the CAD program, and the strength

distribution diagram 23 is then constructed with the strength computation program.

The designers or customers can use these cost estimation table 24 and the strength distribution diagram 23 as references for determining the designs of the building structures. If it is determined that any building structural component shown in the strength distribution diagram 23 has a relatively low safety level, the dimensions of the building structural component can be adjusted to increase the strength of the building structural component. To achieve this adjustment, the corresponding CAD data of this building structural component is changed with the CAD program. Furthermore, changes in the costs due to this adjustment can be checked by retrieving and executing the cost estimation program and printing out the new cost estimation table 24.

As shown in the cost estimation table 24, for example, one species of Japanese cypresses called Chamaecyparis obtusa is used for the bases of the building structure. Since this tree is relatively expensive, less expensive Japanese cypress species called Thujopsis dolabrata can be used for the bases of the building structure. To achieve this change, the corresponding CAD data is changed through the CAD program. Furthermore, changes in the costs due to this adjustment can be checked by retrieving and executing the cost estimation program and printing out the new cost estimation table 24.

After the CAD data is established in the first station A, the wood species data, the shape data and the connection process data of the building structural components contained in the CAD data are transferred to the CAM device 21 through the communication line 20. Then, in step VI of Fig. 2, the CPU (not shown) in the CAM device 21 processes wood materials

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based on these process data.

The described embodiment provides the following advantages.

Since the CAD data can be directly transferred to the CAM device, it is not necessary to input the precut data into the CAM device manually, and the possibility of the input mistakes is advantageously eliminated. Therefore, once the design is established, the wood materials can be immediately processed, so that the process is accelerated.

The cost estimation table 24 and the strength distribution diagram 23 can be easily constructed based on the CAD data.

The CAD data can be adjusted based on the cost estimation table 24 and the strength distribution diagram 23. After the adjustment of the CAD data, the cost estimation table 24 and the strength distribution diagram 23 can be easily reconstructed based on the adjusted CAD data. Therefore, for example, if the customer demands use of less expensive materials, new cost estimation can be made immediately. Furthermore, after the structural design is established based on the cost estimation table 24 and the strength distribution diagram 23, the CAD data can be instantaneously transferred to the CAM device 21, so that the process is accelerated.

If the customer demands design modifications, such as arrangement of a new window in the wall, a column, that should be removed for installation of the window, could be eliminated from the design, and lintels and upper and lower frames for the window could be provided. As a result, the

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CAD data should be modified to meet the customer's demand. In a case of such structural modifications, a new cost estimation table 24 and a new strength distribution diagram 23 can be produced immediately based on the CAD data, so that discussion of the design between the designer and the customer can be promoted.

The estimated cost indicated in the cost estimation table is slightly higher than the actual cost for providing cost tolerance. Therefore, even if the cost is slightly increased within this cost tolerance, the customer will not be asked to pay more and will not be surprised with a bill asking more than the estimated cost.

Since the columns, the beams and the braces serving as the building structural components are colored with the colors indicating the strengths corresponding with the computed stress values of these building structural components, and are displayed on the two-dimensional strength distribution diagram 23, the strengths of these building structural components are visually directly appealed to a viewer with the colors unlike the prior art where only stress values are displayed as numerals, so that the strengths of the building structural components can be more easily recognized with the present invention. Furthermore, since the differences in the strengths of the building structural components can be seen as the differences in the colors of the building structural components, the differences in the strengths of the building structural components can be more easily recognized in comparison to the prior art.

The described embodiment can be modified as follows.

In the described embodiment, the data that are

associated with the structure, i.e., the shape data and the material type (wood species) data, are retrieved by the cost estimation program, and the data that are not directly associated with the structure, i.e., the specification data of the roof materials, the wall materials, the floor materials, and the interior components, such as the stairs, the windows and the doors, are also retrieved simultaneously. Then, the cost estimation is conducted based on these data.

In addition to these data, the data of other components, such as the foundation, built-in furniture and a built-in cloakroom, could be optionally inputted to allow the cost estimation of these components.

In the described embodiment, all data are inputted through the CAD program. However, the data having no direct influences on the construction of the virtual three dimensional model, such as the specification data of the interior components, can be inputted when the cost estimation program is executed.

In the described embodiment, both the cost estimation table 24 and the strength distribution diagram 23 are constructed. Alternatively, only one of the cost estimation table 24 and the strength distribution diagram 23 can be constructed.

The estimated costs of the building structural components indicated in the cost estimation table 24 are higher than the actual costs of the building structural components. Alternatively, these estimated costs can be equal to or lower than the actual costs.

In the described embodiment, the various programs and

data are transferred from the magnetic disk device 14 to the
RAM 13. Alternatively, the programs and the data can be
transferred from other external storage device such as a
flexible disk, a CD-ROM disk, a magneto-optical disk or the
like, to the RAM 13. Furthermore, the data can be
transferred through a data communication network such as a
LAN (Local Area Network), WAN (Wide Area Network) or the
Internet.

The strengths of the building structural components can
be displayed with other sets of colors that are different
from the described set of colors, and the number of colors
contained in each set of colors can be changed as desired.
Furthermore, the strength levels of the building structural
components can be displayed with various line types or with
various shades ranging from black to white. Furthermore, any
marks corresponding with the strengths of the building
structural components can be superimposed on the displayed
building structural components.

The described types of loads and stresses in the
described embodiment are merely examples. In this embodiment,
these loads and stresses are obtained as the most universal
strength determining conditions, and the types of loads
and/or stresses can be increased or decreased.

The printout is not mandatory. Therefore, the printer
is not essential element of the present invention. In a case
of storing the data, any storage means can be used. Examples
of the storage means include magnetic disk devices, RAMs,
flexible disks, CD-ROM disks, magneto-optical disks and so on.
Accordingly, the present embodiments are to be considered as
illustrative and not restrictive, and the invention is not to
be limited to the details given herein, but may be modified

within the scope and equivalents of the appended claims.

WHAT IS CLAIMED IS:

1.   A processing system for processing building structural
components constituting a building structure, said processing
system comprising:
        a first station comprising:
                an input means for inputting at least shape data
and relative position data of said building structural
components;
                a two-dimensional diagram constructing means for
constructing a two-dimensional diagram, wherein said two-
dimensional diagram constructing means first constructs a
virtual three-dimensional model of said building structural
components based on said various data inputted from said
input means and also supplemental data arranged in a CAD
program, and then constructs said two-dimensional diagram by
projecting selected building structural components, which are
selected from said building structural components of said
virtual three-dimensional model, onto a plane;
                a display means for displaying said two-
dimensional diagram constructed by said two-dimensional
diagram constructing means on a display screen;
                a storage means for storing CAD data for
constructing said virtual three-dimensional model constructed
by said two-dimensional diagram constructing means; and
                a strength computing means for computing
strengths of said selected building structural components
based on said CAD data retrieved from said storage means; and
        a second station comprising a processing means for
processing each of said building structural components based
on said CAD data retrieved from said storage means, wherein
said processing means is interconnected with said first
station through a communication line.

2.   A processing system for processing building structural components according to claim 1, wherein said first station further comprises a cost estimating means for estimating costs of said building structural components based on said CAD data retrieved from said storage means.

3.   A processing system for processing building structural components according to claim 1 or 2, wherein said strengths are grouped into a plurality of different bands based on magnitudes of said strengths, wherein each of said strength level display modes is assigned to each of said corresponding bands.

4.   A processing system for processing building structural components according to any one of claims 1 to 3, wherein said two-dimensional diagram constructing means projects a cross section of said virtual three-dimensional model onto said plane, wherein said cross section of said virtual three-dimensional model is obtained by cutting said virtual three-dimensional model at a desired position.

5.   A processing system for processing building structural components according to any one of claims 1 to 4, wherein said strength level display modes are colors provided in said two-dimensional diagram.

6.   A processing system for processing building structural components constituting a building structure, said processing system comprising:
        a first station comprising:
            an input means for inputting at least shape data and relative position data of said building structural components;
            a two-dimensional diagram constructing means for

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constructing a two-dimensional diagram, wherein said two-dimensional diagram constructing means first constructs a virtual three-dimensional model of said building structural components based on said various data inputted from said input means and also supplemental data arranged in a CAD program, and then constructs said two-dimensional diagram by projecting selected building structural components, which are selected from said building structural components of said virtual three-dimensional model, onto a plane;

a display means for displaying said two-dimensional diagram constructed by said two-dimensional diagram constructing means on a display screen;

a storage means for storing CAD data for constructing said virtual three-dimensional model constructed by said two-dimensional diagram constructing means; and

a cost estimating means for estimating costs of said building structural components based on said CAD data retrieved from said storage means; and

a second station comprising a processing means for processing each of said building structural components based on said CAD data retrieved from said storage means, wherein said processing means is interconnected with said first station through a communication line.

7.   A processing system for processing building structural components according to claim 6, wherein said first station further comprises a strength computing means for computing strengths of said selected building structural components based on said CAD data retrieved from said storage means.

8.   A processing system for processing building structural components according to claim 7, wherein said strengths are grouped into a plurality of different bands based on magnitudes of said strengths, wherein each of said strength

level display modes is assigned to each of said corresponding bands.

9.   A processing system for processing building structural components according to any one of claims 6 to 8, wherein said two-dimensional diagram constructing means projects a cross section of said virtual three-dimensional model onto said plane, wherein said cross section of said virtual three-dimensional model is obtained by cutting said virtual three-dimensional model at a desired position.

10.   A processing system for processing building structural components according to any one of claims 6 to 9, wherein said strength level display modes are colors provided in said two-dimensional diagram.

11.   A processing system for processing building structural components according to any one of claims 2 to 10, wherein said costs estimated by said cost estimating means are different from actual costs of said building structural components that are computed based on actual shape data of said respective building structural components.

ABSTRACT

Designing of building structures, reexamining designs
of the building structures and processing of building
structural components of the building structures are
integrally conducted based on CAD data formed with a CAD
device. A cost estimation table is constructed based on data
formed with a CAD program. Furthermore, a strength
distribution diagram of selected building structural
components, which are selected from a virtual three
dimensional model constructed with the CAD program, is formed.
Upon examining the cost estimation table and the strength
distribution diagram, if the design of the building structure
is satisfactory, the structural components are processed with
a CAM device.

1 / 5

F I G. 1

A

F I G. 2

STEP II	STEP I	STEP III
ESTIMATING THE COSTS BASED ON THE CAD DATA	DESIGNING THE BUILDING STRUCTURE WITH THE CAD PROGRAM	COMPUTING THE STRENGTHS BASED ON THE CAD DATA

STEP IV

PROCESSING THE COMPONENTS BASED ON THE CAD DATA
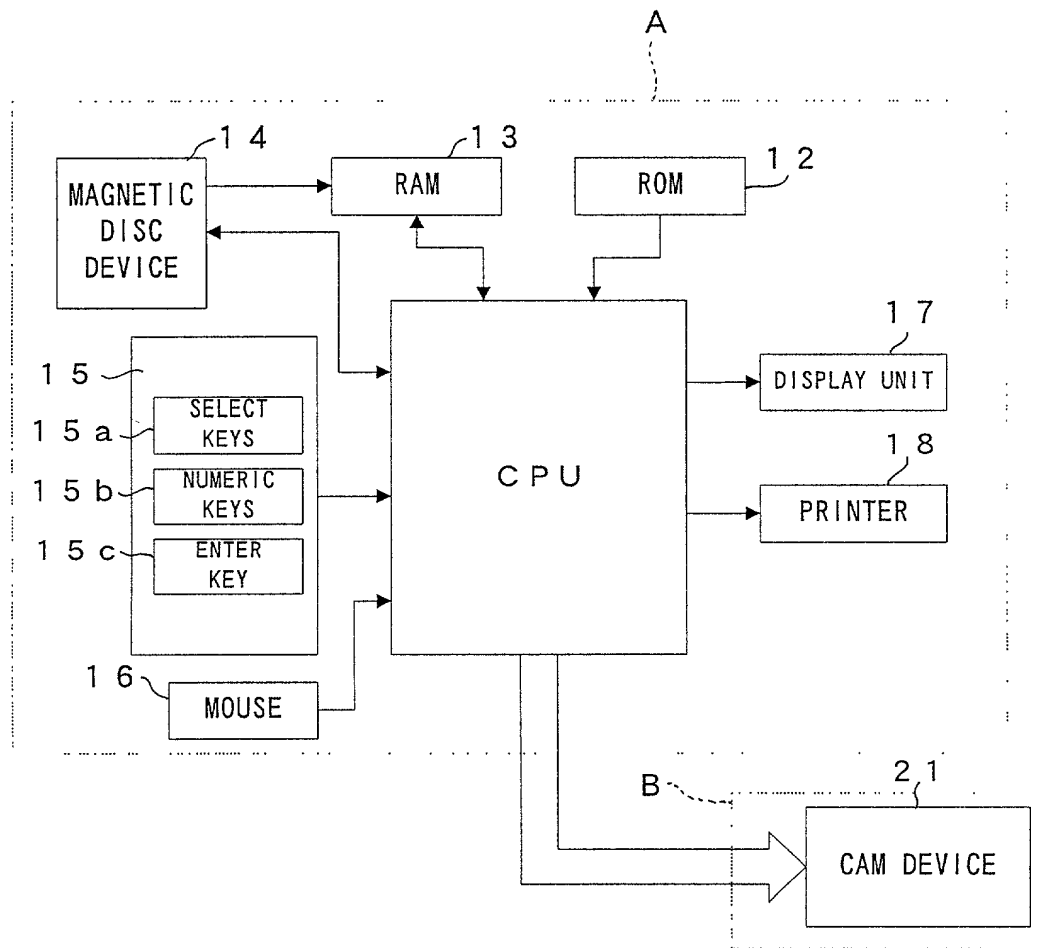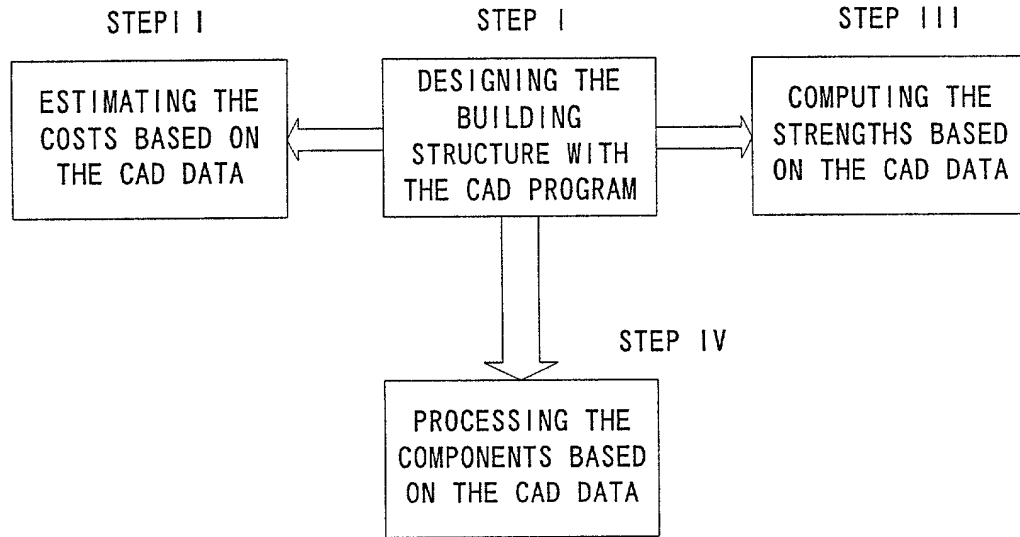
F I G. 3

T 1

	LAST TWO DIGITS (mm)	LAST ONE DIGIT (mm)
LENGTH	0 0 ～ 9 9	
THICKNESS WIDTH		0 ～ 9
CORRECTED VALUE	1 0 0	1 0

FIG. 4

(page3)

<STRUCTURAL COMPONENTS・・・>

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ATTRIBUTES/WOOD SPECIES	LENGTH (mm)	WIDTH (mm)	THICKNESS (mm)	QUAN-TITY	VOLUME	UNIT COST	AMOUNT
COLUMN A/ CHAMAECYPARIS OBTUSA	3000	130	130	12	0.6084	150,000	91,260
COLUMN B/ CHAMAECYPARIS OBTUSA	6020	135	135	10	1.1956	150,000	179,340
COLUMN C/ CHAMAECYPARIS OBTUSA	3000	110	130	20	0.8580	150,000	128,700

FIG. 5

F I G. 6

| BLUE | LIGHT BLUE | YELLOW GREEN | YELLOW | PINK | RED |

0   0.5   1.0   1.5

SAFE ←——→ WARNING

F I G. 7

| NUMBER: | G4 | SECTION | BEAM |

LOAD   WORST ▼

STRESS   WORST ▼

DISPLAY
COLOR

0.0   0.5   1.0   1.5

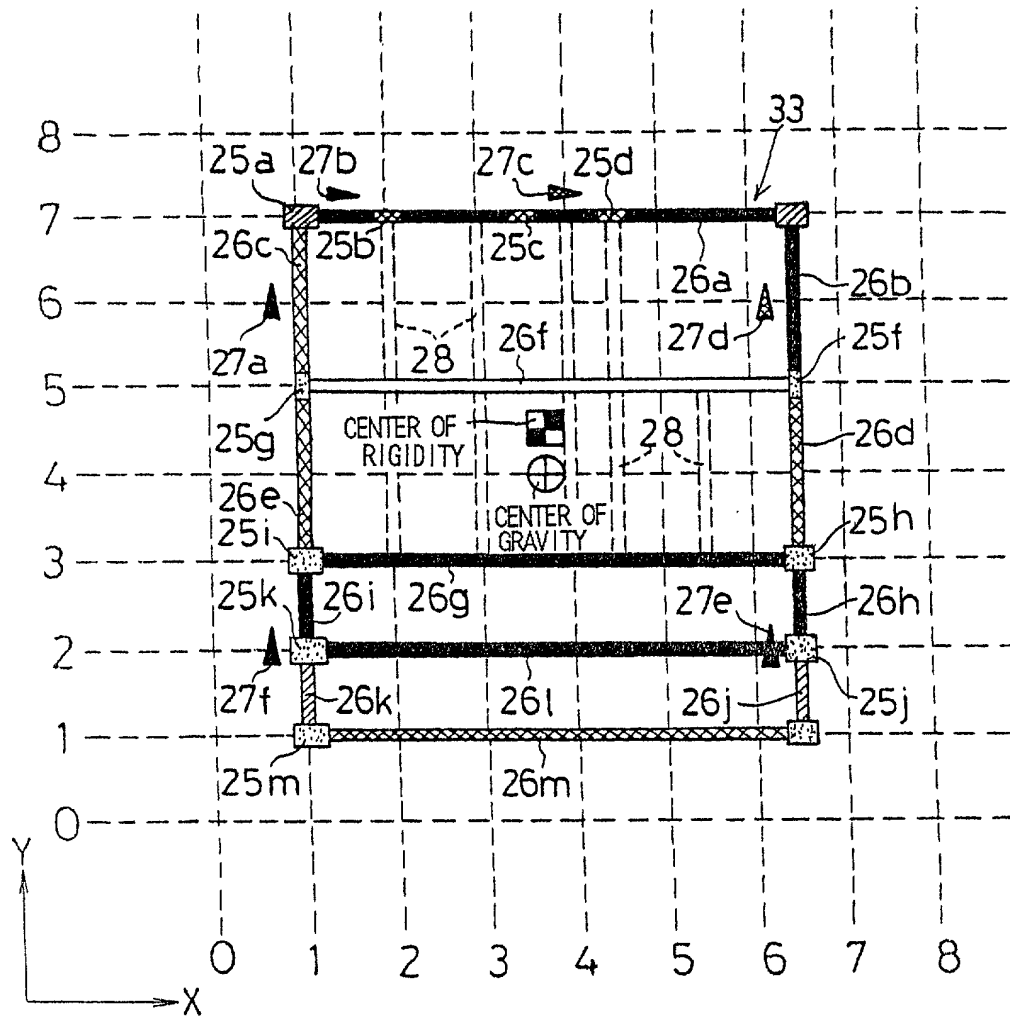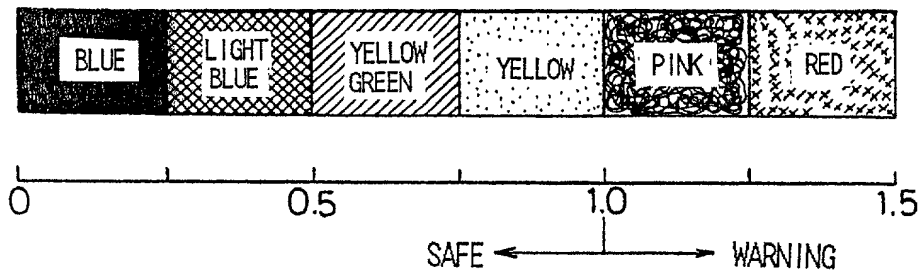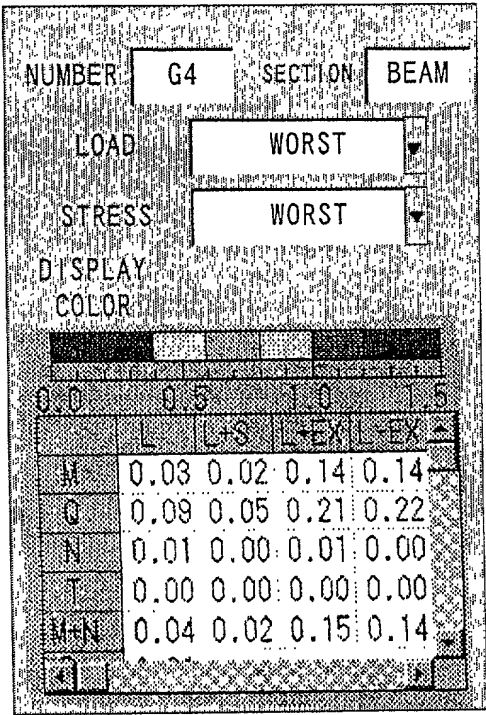|	L	L+S	L+EX	L-EX
M	0.03	0.02	0.14	0.14
Q	0.09	0.05	0.21	0.22
N	0.01	0.00	0.01	0.00
T	0.00	0.00	0.00	0.00
M+N	0.04	0.02	0.15	0.14

DECLARATION AND POWER OF ATTORNEY
FOR ORIGINAL U.S. PATENT APPLICATION

Attorney's Docket No. SHIBP004

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: PROCESSING SYSTEM FOR PROCESSING BUILDING STRUCTURAL COMPONENTS the specification of which,

(check one)

1. ☐ is attached hereto.

2. ☐ was filed on _____ as
U.S. Application No. _____
and was amended on _____.

3. ☒ was filed on 26 August , 1999 _____ as
International PCT Application No. PCT/JP99/04626 _____
and was amended on 21 January ,2000 _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, CFR § 1.56.

Prior Foreign Application(s)

I hereby claim foreign priority benefits under Title 35, United States code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

			Priority Benefits Claimed?
__10/257501__	____JAPAN__	____26 August 1998__	Yes ___No ___
(Application No.)	(Country)	(Filing Date)	
			Yes ___ No ___
_____	_____	_____	
(Application No.)	(Country)	(Filing Date)	

Provisional Application(s)

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below:

_____	_____
(Application No.)	(Filing Date)
_____	_____
(Application No.)	(Filing Date)

Atty. Dkt. No.: SHIBP004   Page 1 of 3

(Revised 03/00)

Prior U.S. Application(s)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application No.)	(Filing Date)	(Status - patented, pending, abandoned)
(Application No.)	(Filing Date)	(Status - patented, pending, abandoned)

Power of Attorney

And I hereby appoint the law firm of **Beyer Weaver & Thomas, LLP** and all practitioners who are associated with the Customer Number 022434 as my principal attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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PATENT TRADEMARK OFFICE

Direct Telephone Calls To: Attorney Name at telephone number (650) 961-8300

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Inventor's signature: _____   Date of Signature:_____

Residence: (City)   _____   (State/Country)   _____

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Atty. Dkt. No.:   SHIBP004   Page 2 of 3

(Revised 03/00)

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Post Office Address: _____

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Inventor's signature: _____ **Date of Signature:**_____

Residence: (City) _____ (State/Country) _____

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